REMARKS

Claims 1-11 are present for examination. The examiner has indicated that claims 9-11 are allowed. Claims 1-8 stand rejected under 35 U.S.C. 103 as unpatentable over applicant's admitted prior art in view of Puskas (5,834,871). The examiner's rejection is respectfully traversed.

The examiner has recognized that applicant's admitted prior art does not disclose the plurality of amplifiers nor the plurality of flexible cables connected to the plurality of amplifiers and the plurality of head units. The examiner cites Figures 9A and 10 of Puskas to supply a teaching of multiple generators applied individually to multiple transducers. However, the Puskas reference is in the field of ultrasonic cleaning and the transducers are ultrasound transducers utilized to clean various materials placed within a liquid. This technology is completely different from the printhead technology in which piezoelectric transducers drive an ink jet printer. One of ordinary skill in the art would not be motivated to look at the ultrasonic cleaning technology when presented with problems in ink jet printing technology.

Moreover, nothing within the Puskas reference itself would suggest utilizing the plurality of generators and individual plurality of transducers in an apparatus according to applicant's invention so that one would not be motivated, absent hindsight reasoning, to combine the two references as done by the examiner. Applicant has solved a problem of ink jet printer print quality deterioration caused by the loss of frequency components of the drive wave form due to the RC filter formed by a total of the resistance of a transmission path and the static capacitance of the piezoelectric elements. One way applicant solves this problem is by distributing the total static capacitance of the piezoelectric elements to a plurality of amplifiers such that the time constant RC is reduced. By reducing this time constant, the piezoelectric elements of the ink jet head unit can be driven effectively and the velocity and size of ink droplets sprayed from the heads can be accurately controlled. Puskas is limited to combinations of generators and transducers that produce ultrasound within a liquid for the purpose of cleaning delicate parts. Puskas simply is not concerned

with print quality deterioration due to the RC of the transmission path and the piezoelectric elements. As such, the Patent and Trademark Office has not made out a *prima facie* case of obviousness under the provisions of 35 U.S.C. 103.

Moreover, applicant's invention is not merely a case of duplicating "essential parts" because a person of skill in the art would not normally want to duplicate any amplifiers, nor flexible cables since such duplication would lead to more complexity and cost. However, applicant has determined that an excellent print image with high quality can be accomplished in accordance with the invention by distributing the total static capacitance of the piezoelectric elements to a plurality of power amplifiers. Thus, even if the resistance for the transmission pulse varies, the time constant is proportional to the static capacitance of the piezoelectric elements. Thus, the loss of the frequency components of the drive wave form signal due to the RC on the transmission path decreases. As a result, even if a plurality of piezoelectric elements are driven, the output signals of the power amplifiers are input to the piezoelectric elements without any deterioration and thus the piezoelectric elements can be driven effectively.

The St. Regis Paper Co. v. Bemis Co., 549 F. 2d 833, 193 U.S.P.Q. 8 (7th Cir. 1977) case cited by the examiner does not apply here because the instant invention, as discussed above, is non-obvious. In St. Regis Paper, the court held that the multiple layering of a bag to create a stronger bag involved only routine skill in the art because it would be "difficult to conceive of a more obvious method of strengthening a certain type of bag than putting one bag inside of another." Id. at 839. Accordingly, St. Regis Paper stands for the simple proposition that an invention as obvious as strengthening a bag by placing one bag inside of another is not patentable. Applicant, on the other hand, achieves an improved print quality by distributing the total static capacitance of the piezoelectric elements among a plurality of amplifiers. Applicant's invention would not have been obvious to one having ordinary skill in the art of ink jet printer technology. Accordingly, the St. Regis Paper case is inapplicable.

In order to further clarify that applicant's invention is in the ink jet technology area and not in the piezoelectric technology area generally, applicant has amended independent

claims 1 and 7 to further describe the head units as "ink jet" head units. The sole purpose and effect of the amendment is to emphasize and highlight the fact that the head units in the invention claimed are "ink jet" head units, as distinguished from piezoelectric head units generally. This amendment highlights that Puskas concerns a completely different non-analogous subject matter, ultrasonic cleaning, than is recited in these claims. Indeed, a search conducted on-line using the PTO website showed that the words "ink" and "jet" do not appear anywhere in the Puskas patent.

The amendments to independent claims 1 and 7 do not raise a new issue. The dependent claims had already limited the claimed invention to ink jet head unit technology, as they discussed the head units spraying ink. See, for example, claims 2, 3, 4, 5, 6, 7, 10, and 11. This distinction is now made explicit, however, by and through the amendments made to independent claims 1 and 7.

In view of the comments set forth about, it is submitted that the Patent and Trademark Office has not made out a *prima facie* case of obviousness and that the pending claims are patentable over the prior art.

The application is now considered to be in condition for allowance and an early indication of same is earnestly solicited.

Respectfully submitted,

August 17, 2001
Date

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Attorney Docket No. 040447-0218

In re patent application of

Kyoichi NARIAI

Serial No. 09/576,492

Filed: May 23, 2000

For: PIEZOELECTRIC ELEMENT DRIVING CIRCUIT AND DRIVING METHOD

Group Art Unit: 2834

Examiner: Karen B. Addison

MARKED-UP VERSION FILED WITH AMENDMENT IN RESPONSE TO FINAL OFFICE ACTION OF JUNE 6, 2001

Commissioner for Patents
Box AF
Washington, D.C. 20231

Commissioner:

This is an amendment in serial number 09/576,492 in reply to the Final Office Action mailed June 6, 2001. Please amend the above identified application as follows:

IN THE CLAIMS:

1. (Amended) A piezoelectric element driving circuit for driving a plurality of piezoelectric elements disposed in a plurality of ink jet head units, comprising:

a plurality of power amplifiers for driving the plurality of ink jet head units;

a plurality of flexible flat cables disposed between said plurality of power amplifiers and the plurality of ink jet head units for connecting the plurality of ink jet head units and said plurality of power amplifiers; and

a drive waveform signal generating circuit for supplying a drive waveform signal to said plurality of power amplifiers and the plurality of ink jet head units,

wherein each of the plurality of ink jet head units has:

a switch device for supplying a piezoelectric element current to the plurality of piezoelectric elements,

wherein said plurality of power amplifiers are disposed corresponding to the plurality of ink jet head units, said plurality of power amplifiers supplying a drive waveform signal that is input from said drive waveform signal generating circuit to said plurality of power amplifiers through said plurality of flexible flat cables so as to drive the plurality of ink jet head units.

7. (Twice Amended) A piezoelectric element driving method for driving a plurality of piezoelectric elements disposed in a plurality of ink jet head units, each of which has a plurality of power amplifiers for driving the plurality of ink jet head units, a plurality of flexible flat cables for connecting the plurality of ink jet head units and said plurality of power amplifiers, and a drive waveform signal generating circuit for supplying a drive waveform signal to the plurality of ink jet head units, the method comprising the steps of:

driving the plurality of power amplifiers so as to amplify the drive waveform signal; and

causing the plurality of ink jet head units to spray large ink droplets, middle ink droplets, or small ink droplets corresponding to the drive waveform signal that is output from the drive waveform signal generating circuit,

wherein when the small ink droplets are sprayed, the time constant of the plurality of power amplifiers that are driven allows the number of piezoelectric elements that are simultaneously driven to become maximum.

8. (Amended) The method as set forth in claim [6] 7,

wherein the time constant of the plurality of power amplifiers that are driven is equal to or smaller than a predetermined value of which all the plurality of piezoelectric elements are driven in the case that all outputs of a latch circuit that latches an output of a data serial parallel converter of each of the plurality of head units are turned on and all switches connected to all the piezoelectric elements are turned on.